

No. 697,312.

Patented Apr. 8, 1902.

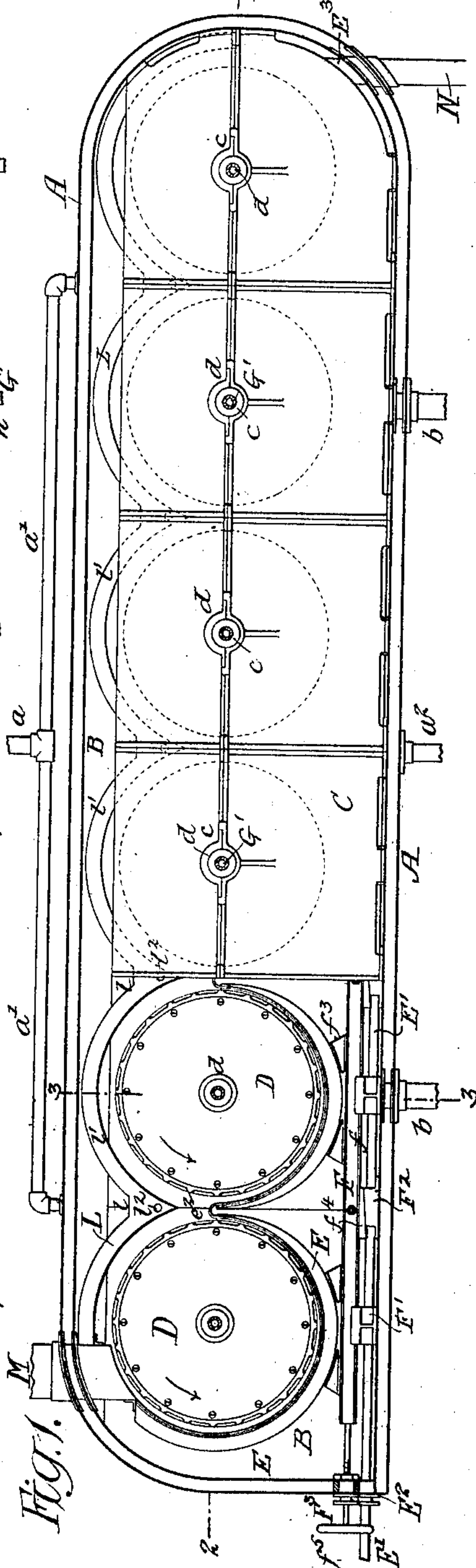
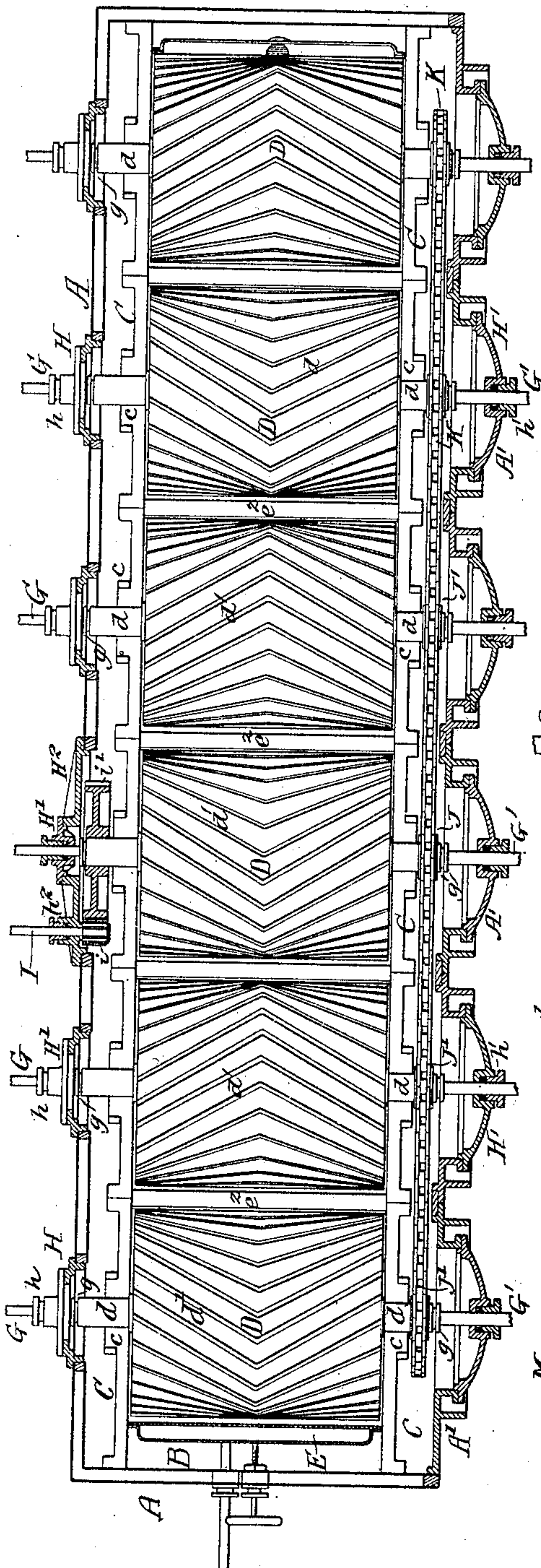
L. ATWOOD.
DRYING APPARATUS.

(Application filed Mar. 23, 1901.)

(No Model.)

3 Sheets—Sheet 1.

Fig. 2.



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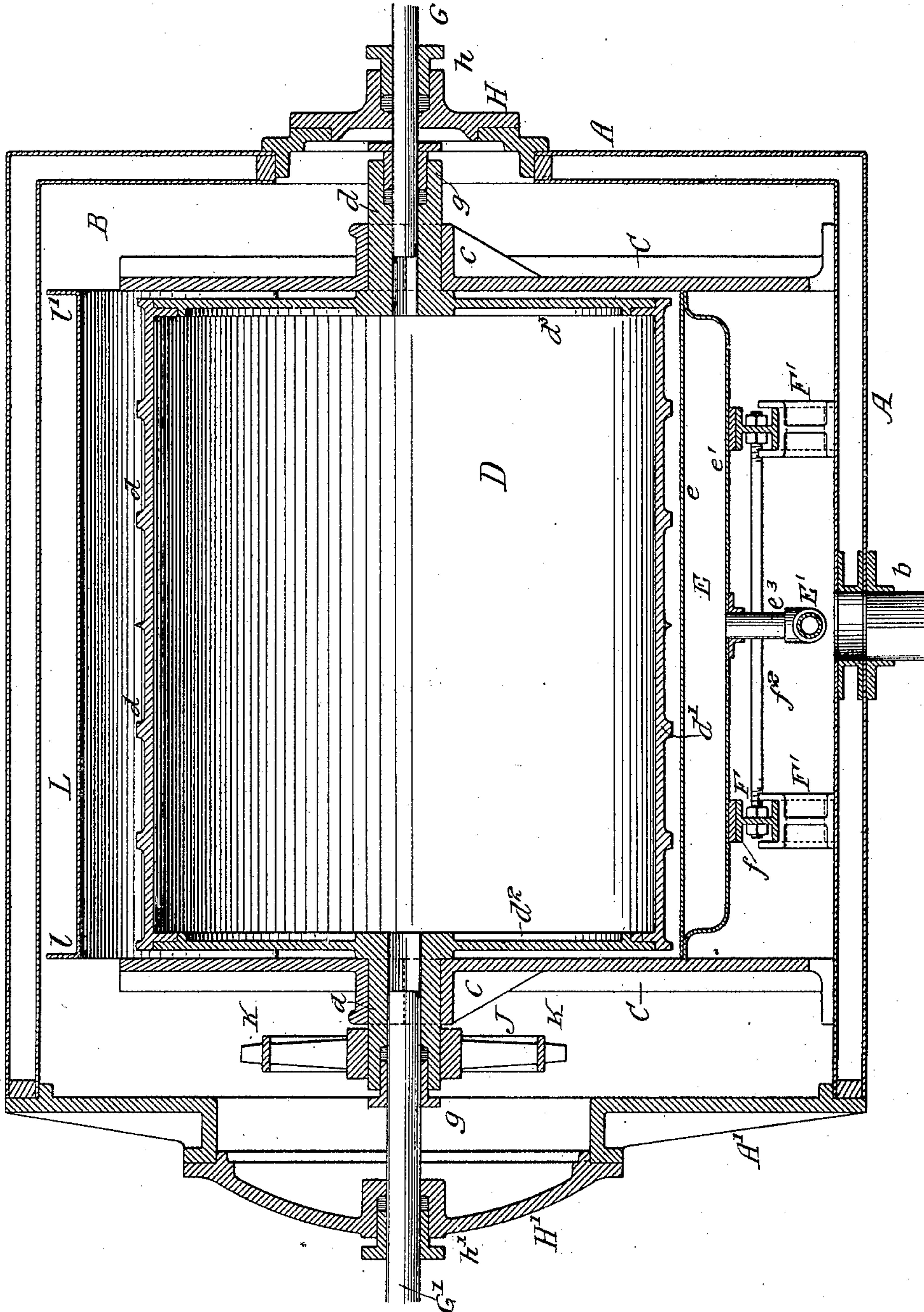
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3 Sheets—Sheet 2.

Fig. 3.



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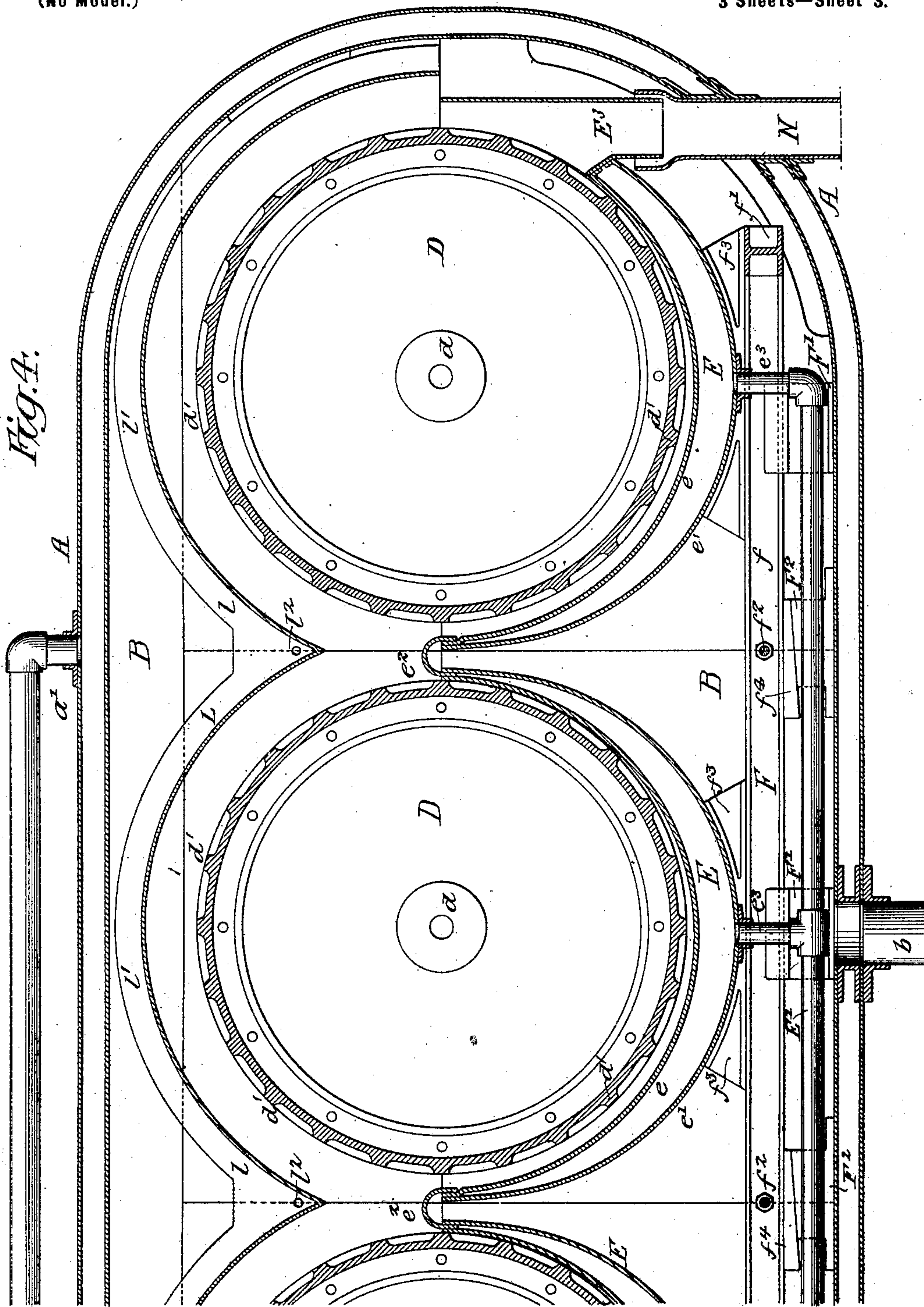
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3 Sheets—Sheet 3.



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UNITED STATES PATENT OFFICE.

LEONARD ATWOOD, OF PHILADELPHIA, PENNSYLVANIA.

DRYING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 697,312, dated April 8, 1902.

Application filed March 23, 1901. Serial No. 52,609. (No model.)

To all whom it may concern:

Be it known that I, LEONARD ATWOOD, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain
5 Improvements in Drying Apparatus, of which the following is a specification.

My invention relates to that class of drying apparatus in which the drying is effected in a chamber wherein a partial vacuum is main-
10 tained.

The main object of my invention is to thoroughly and evenly dry such material as brewers' grain.

A further object of the invention is to provide an apparatus in which material can be continuously treated and in which conveying-
15 belts are avoided.

In the accompanying drawings, Figure 1 is a side view, partly in section, of my improved
20 drying apparatus. Fig. 2 is a sectional plan view on the line 2 2, Fig. 1. Fig. 3 is a transverse sectional view on the line 3 3, Fig. 1. Fig. 4 is an enlarged longitudinal sectional view of the apparatus.

25 My invention is especially applicable for drying brewers' grain from which the excess of water has been extracted. The grain as it enters this machine is by preference of an even dampness throughout, so that the grain
30 as it passes through the machine will be completely and evenly dried. One of the essential objects in drying brewers' grain is to retain as large a percentage of the gluten and other valuable food constituents as possible
35 and to leave the grain in a thoroughly dried condition.

Referring to the drawings, A is a casing having a double wall forming a chamber, the chamber between the walls being a water-
40 chamber supplied with cold water through a pipe *a*, having branches *a'*. The water is withdrawn from the chamber through a pipe *a*². It will be understood that while I have shown in the drawings the supply-pipe com-
45 municating with the top of the chamber and the discharge at the bottom the supply may enter at the bottom and discharge at the top.

The chamber B, surrounded by the casing A, is a vacuum-chamber, partial vacuum be-
50 ing maintained therein by connecting said chamber through a pipe *b*, with an ejector,

air-pump, or other form of exhausting apparatus. (Not shown.)

The casing A is a double casing at top and bottom, at each end, and one side. The oppo-
55 site side is made in sections A', which are detachable, so that the drums D and the curved sections E may be removed for cleansing and for repairs.

Inside the chamber B are two longitudinal
60 frames C C, having bearings *c* for the trunnions *d* of the drums D. These frames are made in sections, so that any number of them can be removed when it is desired to dis-
mantle the machine.

Mounted between the frames C C are curved
65 beds E, over which the material to be dried is carried. The bed E in the present instance is made of two curved plates *e e'*, secured together at each side, as shown in Fig. 3, and
70 secured together at the upper edge, as shown in Fig. 4, forming a chamber for steam or hot air. The segmental beds E conform to the shape of the cylinders D and are set ec-
centric thereto, so that the material can be
75 fed in between the bed and the cylinder, and the space between the two will gradually decrease until the blades touch the cylinders at the discharge end of each section. Curved
80 plates *e*², attached to one section of the bed, overlap the adjoining section, so that the material will be carried over from one section to the other without loss.

E' is a steam-supply pipe extending the full
85 length of the machine and coupled to each of the bed-sections E by short pipes *e*³. The pipe E' extends through a stuffing-box E² in one end of the casing and is so arranged that it can move longitudinally when it is desired
90 to shift the several bed-sections. These bed-sections are mounted on the frame F, consisting in the present instance of two longitudinal beams *f f*, connected together by trans-
verse beams *f'* and tie-rods *f*². Each curved
95 bed-section E rests upon saddles *f*³, mounted on the frame and are secured thereto, so that they are rigid in respect to the frame. The frame F rests on guide-blocks F', mounted on the bottom portion of the casing A, and these
100 guide-blocks are flanged so as to hold the frame laterally. At intervals the frame has a series of tapered blocks *f*⁴, bearing upon

tapered supports F^2 , mounted on the base of the casing A, and on one end of the frame is an adjusting-screw F^3 , which passes through a stuffing-box in the casing. By turning the wheel f^5 on this adjusting-screw the frame is moved longitudinally, and owing to the fact that it is supported on the tapered blocks F^2 it will be elevated when moved in one direction and lowered when moved in the opposite direction. By this means the curved beds can be moved so as to be concentric with the drums D when it is desired to remove any material that would adhere to the beds.

Each drum D has blades d' , in the present instance cast integral with the shell of the drum, although in some instances these blades may be separate from the drum and secured thereto in any suitable manner. The drums have heads d^2 , and their trunnions d are hollow, and each trunnion is supplied with a stuffing-box g , and through the stuffing-box on one side passes the steam-supply pipe G and at the opposite end a steam-exhaust pipe G' . The supply-pipe G passes also through the stuffing-box h and a cap H, secured to the casing A, Fig. 3, while the exhaust-pipe G' passes through a stuffing-box h' in the cap H', secured to the movable section A' of the casing, so that steam or hot air is supplied to each drum as well as to the bed over which the material is traversed. The steam and exhaust pipes are connected in any suitable manner exterior of the casing.

It will be noticed that the drums are driven by a driving-shaft I, which passes through a stuffing-box h^2 in the central cap H^2 and has a pinion i , which meshes with a gear-wheel i' on the trunnion of one of the drums D. On the opposite trunnion of the said drum is a sprocket-wheel J, and on each of the trunnions of the other drums are sprocket-wheels J' , and connecting these several sprocket-wheels is an endless chain K, so that when power is applied to the shaft I motion will be imparted to all the drums, turning them in the same direction.

It will be noticed that the blades of the drums are preferably arranged as shown in Fig. 2, the several blades of the drums being V-shaped and the blades of one drum set directly opposite to the blades of the adjoining drum, so that the material—for instance, as it is fed to the first drum—has a tendency to spread out upon the blade, while the blades of the second drum tend to draw the material toward the center, and this alternate lateral movement of the material as it traverses through the drum subjects all portions of the material to the direct heat of either the drums or the bed.

In order to prevent the moisture which will accumulate on the roof of the chamber B dropping on the cylinders, I preferably place a shield L over the drums, as indicated in the drawings. This shield is curved to conform to the curve of the drums. Shaping the shield in this manner forms gutters l between each

drum. The shield is flanged at each side l' so that any moisture collecting on the roof of the chamber B will be caught by the shield L as it drops instead of by the drums. The outlet-openings l^2 may be provided for each gutter, if desired.

M is the inlet-passage for the material to be treated. The inlet-pipe extends to and preferably rests in contact with the upper edge of the bed E and is so arranged as to not interfere with the sliding movement of the bed.

On the last bed E is a spout E^3 , which extends into the bell-mouth of the outlet-pipe N in the present instance.

The inlet and outlet pipes may be of any form without departing from the main feature of my invention, and any suitable means may be used to regulate the flow of material to and from the apparatus.

The operation of the apparatus is as follows: To produce the partial vacuum in the chamber B, the air must be first driven from the chamber by an inflow of live steam through a suitable valve-pipe, and the air-outlet and steam-inlet being then closed the steam within the chamber will be readily condensed by contact with the cool jacket and the desired degree of vacuum thereby quickly attained. The exhausting device may then be set in operation in order to maintain the vacuum. The material is then allowed to pass into the chamber through the supply-pipe M, steam being admitted to the interior of the drums D and to the chambered bed-plates E, so that the surface over which the material is to travel is heated. The drums are then set in motion, and the material will be carried from the feed-pipe M by the blades of the first drum over the warm surface of the bed E and discharged from the first bed to the second bed, where the blades of the second drum traverse it to the third bed, and so on throughout the machine, the material being finally discharged through the discharge-spout N. As the damp material comes in contact with the heated surfaces of the drums and beds the steam rising from the material will be at once condensed by coming in contact with the cool walls of the casing A, which is jacketed with cold water flowing into the jacket of the casing through the pipes a a' and out of the jacket through the pipe a^2 . Any water of condensation which drips from the roof of the chamber will be caught by the drip-shield L and carried either to the bottom of the chamber or out through a separate outlet. By drying the material *in vacuo* within a cold-water-jacketed cylinder the vapor from the material is immediately condensed and carried off, and the material is thoroughly dried when it reaches the discharge end of the machine. After the machine has been running and should the bed become coated with glutinous material the frame F can be moved longitudinally by its screw-shaft F^3 , so as to bring the curved beds in contact with the surface of the blades of the drums, so that the blades

will scrape the surface of the beds and remove any material adhering thereto, after which the screw can be reversed and the beds can be returned to their normal position with only a portion of the bed in contact with the blades.

While I have shown the blades of each drum made V-shaped and the blades of one drum alternating with the blades of another, the blades may be made in any shape desired without departing from the main feature of my invention.

When it is wished to remove any one of the sections of the machine for repairs or cleaning, only one of the removable side plates may be detached and the drum and bed-section can be withdrawn laterally from the machine. Thus access can be had to any section of the machine without dismantling the entire apparatus.

I claim as my invention—

1. The combination in a drying apparatus, of a jacketed casing, means for supplying cold water to the jacket of said casing, a series of drums within the casing, and a series of curved beds, with an inlet and an outlet whereby material can be fed into the space between the drums and their beds and conveyed by the drums over the surface of the beds and discharged, substantially as described.

2. The combination in a drying apparatus, of a jacketed casing, means for supplying cold water to the jacket of said casing, a series of drums within the casing, a series of curved beds, an inlet and an outlet whereby material can be fed into the space between the drums and their beds and conveyed by the drums over the surface of the beds and discharged, with means for heating the drums, substantially as described.

3. The combination in a drying apparatus, of a jacketed casing, means for supplying cold water to the jacket of said casing, a series of drums within the casing, and a series of curved beds, an inlet and an outlet whereby material can be fed into the space between the drums and their beds and conveyed by the drums over the surface of the beds and discharged, with means for heating the beds, substantially as described.

4. The combination in a drying apparatus of a casing, a series of hollow drums mounted therein and provided with blades constructed to give material operated upon a lateral to-and-fro motion at the same time as said material is moved ahead through the apparatus, means for revolving said drums, a series of beds mounted under the drums and so connected that material discharged into the space between the first drum and the bed will be conveyed by said drums over the surface of the other beds, substantially as described.

5. The combination in a drying apparatus, of a jacketed casing, means for supplying cold water to the jacket thereof, an exhaust-pipe for the casing so that a partial vacuum can

be formed within the chamber, a drum, blades thereon, means for heating the drum, a curved bed under the drum, means for heating the bed, an inlet and an outlet for the material to be dried, substantially as described.

6. The combination of a jacketed casing, means for supplying cold water to said casing, an exhaust-pipe for the chamber formed by the casing, a series of drums within the casing, means for driving said drums, blades on the drums for conveying the material, a series of chambered beds, and means for supplying heat to the drums and to the beds, substantially as described.

7. The combination of a jacketed casing, means for supplying cold water to said casing, an exhaust-pipe for the chamber formed by the casing, a series of drums within the casing, means for driving said drums, blades on the drums for conveying the material, a series of chambered beds, and means for supplying heat to the drums and to the beds, said casing having a detachable side made in sections, whereby any one of the drums or beds can be removed, substantially as described.

8. The combination of an elongated casing jacketed on three sides and provided with a removable fourth side, a series of drums with bearings supported by the casing, said drums being hollow and each having a steam inlet and outlet, a bed made in a series of curved sections one mounted below and concentric with each drum, and each having a chamber with a supply-pipe for leading steam to said chamber, substantially as described.

9. The combination of a casing, a series of drums mounted therein, means for driving said drums, a bed for material to be dried, the same being curved to conform to the shape of the drums and means for moving the bed in an approximately horizontal plane, thereby altering its position relatively to the drums, substantially as described.

10. The combination of a casing, a series of drums, blades on said drums, means for driving the drums in one direction, a bed made up of a series of curved sections, a frame on which the curved sections are mounted, and means for moving said frame so as to move the sections of said bed in unison in respect to said drums, substantially as described.

11. The combination of a casing, a frame within said casing, a series of drums having trunnions, bearings on the frame on which the trunnions are mounted, means for driving said drums in unison, each of said drums having blades upon its outside surface constructed to convey material, a bed made up of a series of curved sections mounted between the frames within the drums, an inlet for material and an outlet therefor, substantially as described.

12. The combination in a drying apparatus of a casing, a series of drums therein, means for supplying heat thereto, the bed under the said series of drums being curved to conform to the shape of the drums, means for heating

the said bed, each drum having V-shaped blades, the blades of alternate drums being inclined in opposite directions, thereby causing the material operated upon to have a lateral to-and-fro motion as it is conveyed by the drums through the machine, substantially as described.

13. The combination of a casing, a series of drums mounted within said casing, means for heating the drums, said drums having a bed curved to conform to the drum, means for heating the bed, a shield curved to conform to the shape of the drums mounted between the drums and the roof of the casing so as to collect the water of condensation that may drop from the roof of the casing, substantially as described.

14. The combination of a casing, a series of drums mounted therein, a series of sections curved concentrically to the drums and forming a bed for material to be dried, said drums having blades by which material is fed over the bed, each section of the bed having a

curved lip extending between it and the adjoining section and an inlet and outlet for the material, substantially as described.

15. The combination of a casing, a series of drums mounted therein, means for heating the drums, a series of curved sections forming a bed over which the material to be operated upon is conveyed by the drums, a frame on which the bed is supported, inclined blocks secured to said frame, an inclined bearing-block on which the inclined blocks of the frame rest, and means for moving the frame in a horizontal plane and with it the bed, whereby one side of the sections forming the bed is brought toward or from one side of the drums, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

LEONARD ATWOOD.

Witnesses:

WILL. A. BARR,
JOS. H. KLEIN.